GLOBAL
Diving & Salvage Incorporated

SALVAGE PLAN
USCG
Spirit of Sacramento Salvage

Submitted To:

United States Coast Guard

Submitted By:

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Association of Diving Contractors International

AGC Associated General Contractors of Washington

American Salvage Association

Title: Spirit of Sacramento Salvage Plan

Location: False River near Bethel Island, CA

Date: September, 2012

Client: United States Coast Guard

Scope of Work: Provide salvage services to parbuckle, raise and defuel capsized passenger vessel "Spirit of Sacramento".

In order to provide information in a clear and concise manner the Salvage Plan has been divided into sections identified by the following headings.

Contents

This document is to assist the various interested parties in determining impacts upon such issues as safety, the environment, waterways and shipping, commercial facilities and recreational areas of the wreck, the casualty and the salvage operation. This plan is not intended to replace the expertise of a qualified Salvage Master, Salvage Engineer or Naval Architect, nor is this plan intended to incorporate all safety issues commensurate with a vessel salvage operation.

This plan was developed with considerations given to the client, the resources the client has available to assist with the project, the resources that are available in the San Francisco Bay Area at this time, and the best method to accomplish the goal safely and economically.

Respectfully Submitted,
GLOBAL DIVING AND SALVAGE, INC

Kyle Watson
Salvage Officer

General Information

Sometime on the night of Saturday September 3, 2016, the Spirit of Sacramento began flooding which caused the vessel's stern to sink, which ultimately lead to the vessel capsizing. The vessel was at anchor on the False River pass at the time of the incident, and remains capsized in that location.

On September 5, 2016, Global Diving conducted an underwater survey to obtain information in the development of this plan.

The scope of this plan encompasses the parbuckling, raising and defueling of the vessel.

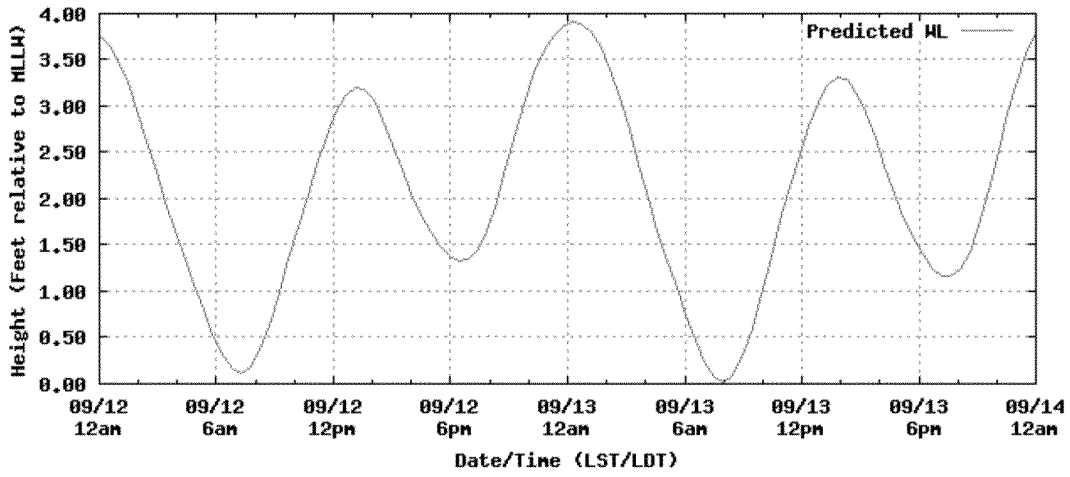
Site Conditions

The Spirit of Sacramento is located at coordinates 38 02.660 N and 121 38.187 W which is a position in False River just north of Bethel Island. Tidal forces create currents upwards of 3 knots on the flood in this area.

Diving conditions should be challenging, but within the norms of diving in San Francisco Bay Area and Delta waters. The sub-aqueous visibility at the site will be 2' to 4' depending on the day and underwater activity.

The sea floor at the site of the casualty consists of compact mud. Natural sea bottom elevation at the site ranges between approximately 20' at the bow and 30' at the stern of the casualty.

Tidal ranges are between 3' and 4' between high and low tides. Currents are strong in excess of 2 knots, which may limit dive operations to periods of lesser current (less than 2 knots).



Vessel Information

The Spirit of Sacramento is 87' in length with a beam of 28'. She has a molded depth of 5.2'. Her normal draft is unknown.

Global has been provided an incomplete set of drawings. Based on analysis of the drawings we have calculated the weight required to parbuckle and raise the vessel per the following calulations:

Geometry Model

The lines for the hull are taken from chine and edge deck lines as shown in various historical drawings for the vessel and then mapped to a similar hull form. The hydrostatics for model are with 5% of an SHCP report for the vessel, dated Nov'96. The main deck aprons were added to match the Thomas Wilson Dwg "Capacity Table & Structure Below the Main Deck", dated 1981. It should be noted that the hydrostatic model ends 85 feet aft of the forward perpendicular not including the apron. While there is likely some buoyant volume outboard of the paddle wheel, it is likely very small. The upper decks were added to the model with some dimensions taken from drawings and others estimated from photographs. Note also that the outboard extents of the deck house (particularly on the 02 deck) are important in estimating parbuckling forces, as such the uncertainty in deck house dimensions should be considered in reviewing the parbuckling analysis. Compartmentation was added the hull to match the latest stability letter.

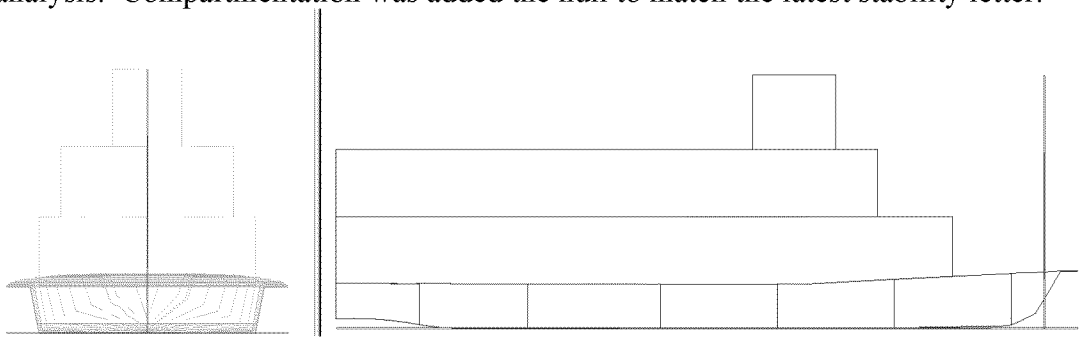


Figure 1: Geometry Model

Establishing the Current Condition

The most recent stability letter lists a lightship of approximately 151 long tons with a VCG 8.1 ft above baseline. Recent pre-casualty drafts or loading information is unavailable. As a result, this analysis was performed over a range of displacements and VCG's which are assumed to encompass the actual pre-casualty condition. The lightship weight and LCG is a lower bound on loaded displacement. An upper bound was taken at 210 long tons of loaded displacement with a VCG 10.2 ft above baseline. Based on the vessel's condition, our best estimate of the vessel's displacement is 180 long tons with a no higher than VCG 9.2 ft above baseline (~ 4ft above the main deck!). The table below shows the range of vessel weight and VCGs considered in this analysis. The heavy condition was studied with a broad range of VCG's to better understand the worst case parbuckling forces.

Name	Weight (Long Ton)	VCG (ft ABL)
Lightship	151	8.1
Best Estimate	180	9.2

Heavy – Low VCG	210	8.1
Heavy – Medium VCG	210	9.2
Heavy – High VCG	210	10.2

It is very likely that there are no watertight compartments in the deck house, and it is unclear which, if any compartments in the hull are tight. Every compartment in the model was assumed flooded to the static waterline. In the event that more information about compartment condition (particularly in the hull) becomes available, this analysis will be updated accordingly. The model was inverted and placed at a heel angle approximated from pictures of the wreck. Ground points were added to the model assuming water depths of 20 ft at the bow and 30 ft at the stern. Ground points were applied to the chine, deck edge, and deck house edges so that when rolling the model, the points of ground contact would be approximately correct for every heel angle

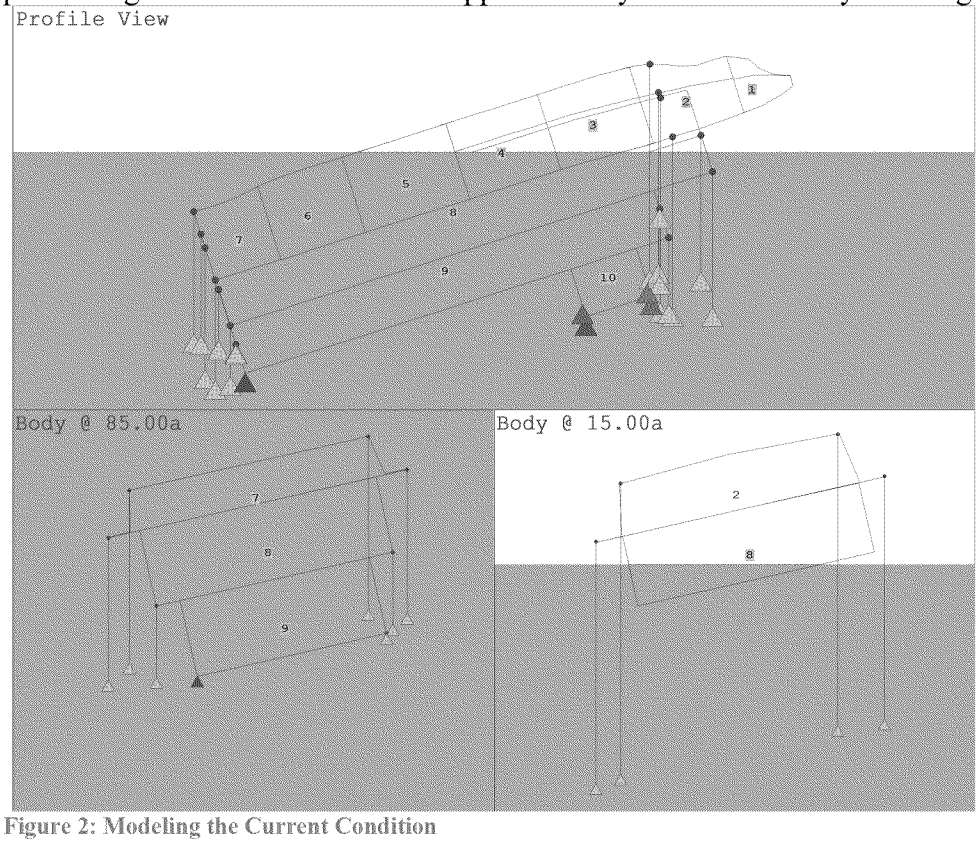


Figure 2: Modeling the Current Condition

Parbuckling Analysis

In order to estimate the crane forces required for parbuckling the wreck, an analysis was conducted which evaluated the forces required to rotate the model through the range of heel angles until approximately upright. Lift points were applied to the model, simulated as additional ground points. Based on the parbuckling rigging arrangements, the location of the lift points was altered as the model rotated. Initially the lift points were placed at the port deck edge of the 02 deck, fore and aft. The lift points were raised incrementally, and the required lift force was recorded. Note that because of the slope of the bottom and

associated trim in the model, it was only necessary to lift on aft lift points. When the model rotated to less than 130° of heel the lift point were shifted to the starboard deck edge of the 02 deck.

Figure 3 shows the results of this analysis over the range of presumed displacement and VCGs. As expected, based on the model's geometry, the results show two distinct phases of the parbuckling operation. The first phase takes the wreck from its current condition to approximately 155° where it partially self-rights to sit on its side. The second phase takes the wreck from approximately 104° of heel to the next self-righting angle which varies based on VCG and weight between 87° and 76° of heel. In each case the final resting condition is approximately 12° of heel and 8° of trim by the stern, to match the assumed bottom slope. In general, the lift force requirements increase with both weight and VCG, making the 210 long ton and 10.2 ft VCG the worst case. Using these conservative assumptions, the maximum hook loads are 26 and 90 short tons in the 1st and 2nd phases, respectively. However, in our judgement, these assumptions are likely overly conservative, and using our best estimate of the vessel's actual weight and VCG, the maximum hook loads are actually 20 and 60 short tons respectively. (Our best estimate case is shown in the solid black line in Figure 3.)

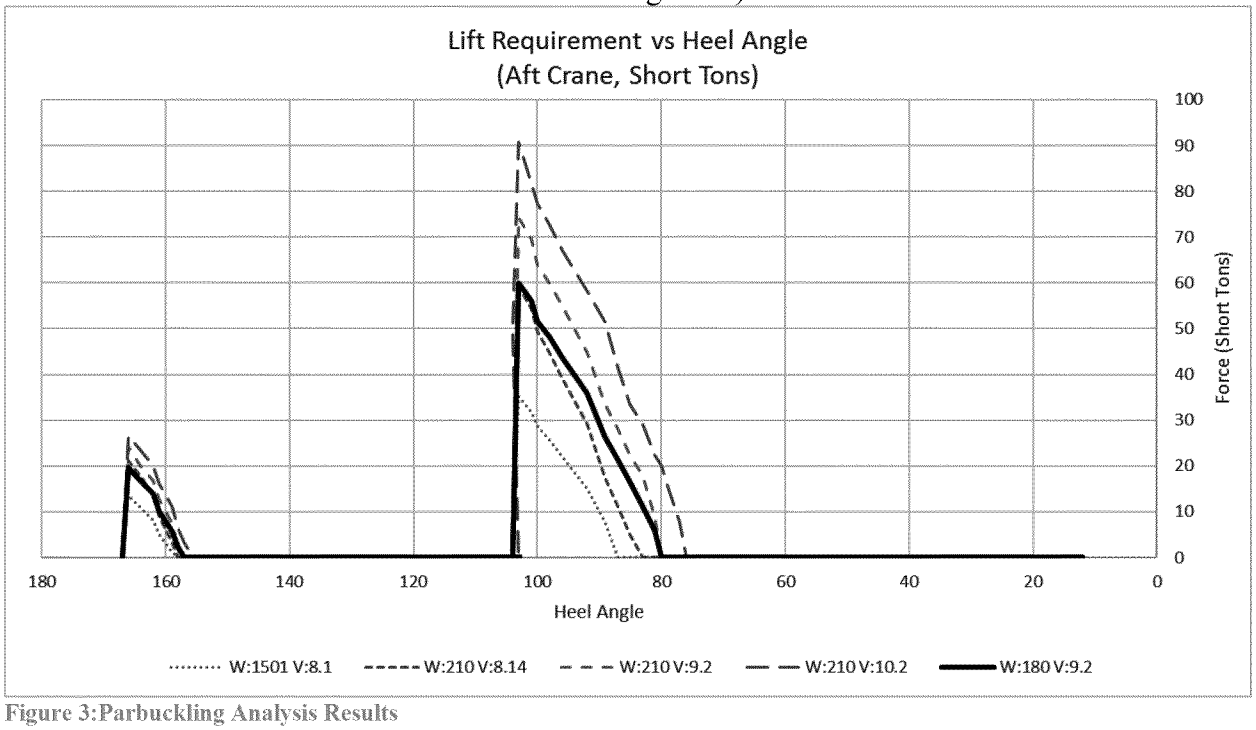


Figure 3: Parbuckling Analysis Results

As mentioned previously, the breadths of the upper decks are not precisely known. We are more confident in the deck heights - which more directly govern the relevant moment arm. Still, there is some uncertainty in the parbuckling "pull points." Additionally, the bottom topography will also affect the parbuckling forces. Accordingly, there is some additional uncertainty with the results shown in Figure 3. However, given that the most conservative cases were still within the lift capacity of the intended cranes, the analysis still strongly suggests that the proposed cranes will be sufficient.

Refloating

Once the wreck has been rotated to be nearly upright, it will be rigged for a simple lift to the surface. The model suggests that in order to get the main deck awash, the hook loads are estimated to be 99 short tons at the bow and 97 short tons at the bow. Entrained water in the house could add significantly to those estimates. Care will be taken to ensure that the upper decks are permitted to drain adequately.

Salvage Response Operations

The operation is a parbuckling and then lifting operation. The operation will take place utilizing two cranes.

Overall Concept

In order to facilitate the lift, the following procedures are anticipated.

- Salvage divers will weld reinforcing steel gussets to the aprons in four locations to reinforce the steel which will take load during the parbuckling evolution
- Parbuckle rigging (2.5" Stud-link Grade 3 ABS Anchor Chain) will be deployed from the port cleats, over the top of the inverted hull, down and under the superstructure, and back up to the water's surface. This will be completed on both the bow and stern locations approximately 20' from each end of the vessel.
- Catch chains (2.5" Stud-link Grade 3 ABS Anchor Chain) will be deployed from the starboard cleats over the inverted hull of the vessel. As the vessel is parbuckled, the catch chains will fetch up and prevent the vessel from rolling past vertical.
- Lifting chains (2.5" Stud-link Grade 3 ABS Anchor Chain) will be deployed across the hull of the vessel while in the inverted position, with the chain being lashed to the sides of the vessel in several locations to prevent sliding. These chains will be rigged into for lifting the vessel after she is parbuckled. These chains will be pre-installed so as to save time that would otherwise be required to pass the chains under the hull after parbuckling.
- Parbuckle rigging, catch chains and lifting chains will all be installed with the assistance of the DB Kelso
- Once all rigging has been installed and all gussets have been welded in position, Global will mobilize the DB 24 (operated by The Dutra Group) and the DB Victory (operated by Vortex Marine Construction).
- The DB 24 and DB Victory will position themselves perpendicular to the casualty with the DB 24 located on the stern and the DB Victory located on the bow.
- The DB 24 and DB Victory will hook into their respective stern and bow parbuckle rigging and catch chains. The lifting chains will be left disconnected at this point.
- The DB 24 will carry the majority of the parbuckle load with the DB Victory carrying a lesser amount. The cranes will simultaneously increase their load until

the vessel rolls onto her side. The vessel is anticipated to be stable in this position. The cranes will relieve their loads on the parbuckle rigging. The cranes will spud up and will be shifted closer to the wreck to increase load capacity.

- Once spudded down in the closer location, the cranes will again increase their load on the parbuckle rigging causing the vessel to complete her roll to the vertical position. The catch chains will prevent the vessel from rolling past vertical.
- The cranes will again spud up and move closer to the wreck to increase load capacity.
- The DB 24 will hold the vessel by the parbuckle and catch chain, keeping the vessel stable in the vertical position. The DB Victory will lower its load. Divers will remove the parbuckle and catch chain rigging from the DB Victory and then connect the lifting chains to the DB Victory. The DB Victory will then take a strain on the lifting chains which will keep the vessel stable.
- The DB 24 will then come down on her load and divers will disconnect the parbuckle and catch chains and then connect the lifting chains to the DB 24.
- The DB 24 and DB Victory will then simultaneously lift the Spirit of Sacramento, stopping intermittently to allow water captured in the superstructure to drain out. Once the decks are awash, dewatering pumps will be used to remove water from inside the hull.

Derrick Barge #24

Barge Built By:	F.M.C. - 1968 - Portland, OR
Crane Built By:	Clyde Iron Works
Dimensions:	150 x 54 x 13
Gross Tons:	950
ABS:	N/A
Line Pull:	Normal 55,000 lbs
Line Speed:	300 FPM

Spuds:	Skagit G-140
Anchor System:	Skagit G-140 -4 drum back-to-back
Fleeting System:	Clyde Frame 6 - 4 drum back-to-back
Lifting Capacity:	Revolving 119 short tons with 125ft boom at 40ft radius
Main Hoist Eng.:	D353 Cat Series E
Gen. Eng.:	N855-G Cummins
Buckets:	12yd cable arm environmental, 9yd Atlas - 9yd Maginnis, 6yd Eerie - 5 yd Blaw-Knox

DB Victory

D.B. VICTORY

Barge Stability Analysis with 190' Boom

PREPARED FOR: Vortex Marine Construction, Oakland, California	BY: Bradley G. Lamkin, P.E., PROJECT ENGINEER
THE GLOSTEN ASSOCIATES	CHECKED: John A. Springer III, P.E., PRINCIPAL-IN-CHARGE
	APPROVED: John A. Springer III, P.E., PRINCIPAL-IN-CHARGE
DOC: — REV: — FILE: 07024	DATE: 8 June 2007

EXPIRES: 04/23/08

References

1. Glosten Drawing 07024-02, "D.B. Victory, 30' Boom Insert"
2. Glosten Report, D.B. Victory – Boom Strength Analysis for 190' Boom, Rev -, Dated 7 June 2007
3. Hal Hockema Report "D.B. Justin, 140'x70'x12.5' Derrick Barge, Stability Booklet"
4. 46 CFR 173.020 – Intact Stability Standards: Counterballasted and Non-Counterballated Vessels
5. Gulfport Shipbuilding Dwg 55000, 100 Ton Floating Crane, General Arrangement
6. Gulfport Shipbuilding Dwg 55039, 100 Ton Floating Crane, Lines and Docking Plan

Summary

Based on the following stability calculations and the structural calculations in Reference 2, the following load guidance is proposed for the D.B. Victory when using 190' of boom with the insert build according to Reference 1.

Load Radius	Hook Load	
	Stern Pick	Full Revolving
Feet	Kips	Kips
50.00	260.0	224.0
55.00	260.0	213.0
60.00	260.0	202.0
65.00	250.0	190.0
70.00	238.5	179.0
75.00	226.0	171.0
80.00	214.0	164.0
85.00	202.0	152.0
90.00	190.0	143.0
95.00	177.5	138.0
100.00	165.5	132.0
105.00	155.0	127.0
110.00	146.5	121.0
115.00	138.0	116.0
120.00	130.0	111.0
125.00	121.5	106.0

Load Radius	Hook Load	
	Stern Pick	Full Revolving
Feet	Kips	Kips
130.00	113.0	101.0
135.00	104.5	95.0
140.00	96.0	90.0
145.00	87.5	85.0
150.00	79.0	79.0
155.00	71.0	71.0
160.00	62.5	62.0
165.00	56.5	57.0
170.00	51.0	51.0
175.00	45.0	45.0
180.00	39.0	39.0
185.00	33.0	33.0
190.00	27.5	28.0
195.00	21.5	22.0
200.00	16.0	16.0
205.00	10.0	10.0

It should be noted that this is not the certified load chart, but is intended to provide a summary of the calculations contained in this report.

Diving will be performed off of a 110'x40' spud barge provided by CS Marine. Dives will utilize Surface Supplied Air.

All communication between cranes, towing vessels, and dive supervisors will be through VHF radio.

Salvage Personnel and Responsibilities

The following is a list of personnel and their responsibilities.

Salvage Supervisor	-Kyle Watson Supervision of the effort as a whole. Will coordinate all phases of the lift and give direction to all parties involved.
Barge Masters	-TBD Follow direction of the Salvage Supervisor. Verify all rigging is sound. Monitor barge and crane for safety. Coordinate movement of barges
Crane Operators	-TBD Follow direction of the Barge Masters, or Dive Supervisor when a diver is in the water. Operate cranes and monitor loads.
Dive Supervisor	-Dave Partlow Follow direction of the Salvage Supervisor. Supervise the divers in their specific tasks.
Divers	Follow direction of the Dive Supervisor. Fabricate and weld in gussets. Place rigging, hook up rigging to cranes, monitor lift.
Tenders/Standby	Follow direction of the Dive Supervisor. Tend the divers as they perform their specific tasks. Handle rigging when required to do so.

This crew will be briefed on the specifics of the job as a whole and their responsibilities to it. All questions will be answered and operations will only proceed when the Salvage Supervisor deems it prudent. All Supervisors will stay in close communication with the Salvage Supervisor and will alert him to any problems. The crew will remain in place and not be traded out in shift changes until directed to do so.

Pollution Control

It is anticipated that there will be some pollution release during the parbuckling and raising of the vessel. Pollution response equipment will be maintained on site for immediate response.

Vessel Delivery

As of the time of writing this plan, it is unclear what the final disposition of the vessel will be after raising. Global will coordinate with the USCG to determine the most prudent location to complete the defueling of the vessel and where the vessel will ultimately be moored after raising.

\NOTE

This Plan is dynamic and subject to change as a result of survey and changes in conditions.